Development of an ISO Standard for Wind Profiler Radars

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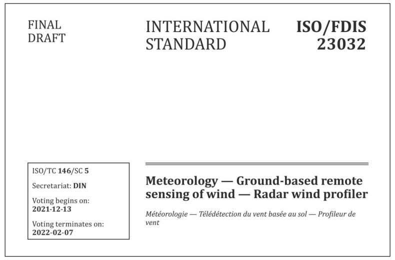
Observed meteorological data are widely used in the weather services of national meteorological agencies, agriculture, industry, commerce, and so on. To ensure the accuracy of observed meteorological data, international standards for meteorological instruments have been formulated. An International Organization for Standardization (ISO) standard for wind profiler radar (WPR), an instrument for measuring height profiles of wind velocity in the clear air, is being developed.

Both the weather varying from day to day and the climate changing with a time scale longer than several decades significantly affect the human society. To investigate atmospheric phenomena in the past, to know current weather conditions, and to predict the weather and climate change, it is imperative to collect high-quality, publicly-available meteorological data. ISO/Technical Committee (TC) 146/Subcommittee (SC) 5 has been developing ISO standards for meteorological instruments. TC 146 addresses air quality, and SC 5 is dedicated to meteorology. The Commission for Observation, Infrastructure and Information Systems (INFCOM) of the World Meteorological Organization (WMO) investigates atmospheric measurement methods and standards for meteorological instruments. SC 5 develops ISO standards as technical guidelines for meteorological instruments, and it communicates closely with INFCOM in their developments. Working Groups (WGs) of SC 5 have formulated the ISO standards for anemometers, thermometers, laser radars (lidars), and weather radars. The Japanese Industrial Standards Committee (JISC), the ISO representative of Japan, has organized domestic committees on the ISO standards.

WPR measures height profiles of wind velocity in the clear air with high time resolution (typically from 10 minutes to an hour). It detects echoes from irregularities of the radio refractive index generated by turbulence (clear-air echoes) and retrieves the wind vector using the Doppler shifts of the clear-air echoes. ISO/TC 146/SC 5/WG 8, established in November 2017, is developing the ISO standard for WPR. WG 8 includes experts from France, Germany, Japan, the United States of America, and other countries. The convenor of WG 8 is Dr. Volker Lehmann of the Deutscher Wetterdienst. WG 8 has issued the Working Draft (WD), Committee Draft (CD), and Draft International Standard (DIS). Now the development of the ISO standard for WPR is in the stage of Final Draft International Standard (FDIS).

The domestic committee in Japan includes representatives of the Japan Meteorological Agency which operates the WPR network named WINDAS, manufacturers that have experiences of WPR development and production, and research institutes that have been carrying out research and development of WPR measurement techniques and studying atmospheric science using WPRs. The Japan committee has contributed greatly to the development of the ISO standard by submitting proposals that meet international requirements for the design, production, installation, operation, and maintenance of WPRs. NICT, participating in WG 8 as an expert from Japan, has facilitated international agreements through discussion and coordination of proposals from Japan and other countries. The third international conference in May 2019 was held at the NICT's open space for research in Osaka, Japan. Adaptive clutter suppression (ACS) is a technique to mitigate undesired echoes (clutter) by using adaptive antenna arrays, and range imaging (RIM) is a technique to enhance vertical (range) resolution by using frequency diversity. NICT has contributed to demonstrating their usefulness. In the ISO standard for WPR, ACS and RIM are recommended as a technique to mitigate clutter and that to enhance vertical (range) resolution, respectively.


FINAL DRAFT
INTERNATIONAL STANDARD
ISO/FDIS 23032

ISO/TC 146/SC 5
Secretariat: DIN
Voting begins on: 2021-12-13
Voting terminates on: 2022-02-07

Meteorology — Ground-based remote sensing of wind — Radar wind profiler

Météorologie — Télédétection du vent basée au sol — Profileur de vent

Cover of FDIS.

YAMAMOTO Masayuki

Planning Manager, Evaluation Office, Strategic Planning Department (Until Dec. 31, 2021) Senior Researcher, Remote Sensing Laboratory, Radio Propagation Research Center, Radio Research Institute

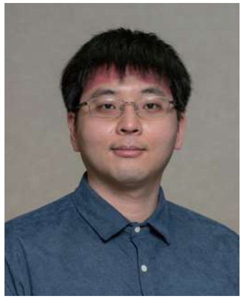
After completing a master's course at graduate school, he worked in industry as an engineer and then at university as an assistant professor before joining NICT in 2015. He is engaged in the research of atmospheric remote sensing. Ph.D. (Informatics).

KAWAMURA Seiji

Director of Remote Sensing Laboratory, Radio Propagation Research Center, Radio Research Institute

After completing his doctorate, he served at Communications Research Laboratory (currently NICT) as a postdoctoral fellow for the Japan Society for the Promotion of Science (JSPS), and then joined NICT in 2006. He is engaged in the research of radar remote sensing. Ph.D. (Informatics).

Land Surface Observation using Airborne Synthetic Aperture Radar (SAR) and Information Extraction from SAR data



GOCHO Masanori

Fixed Term Researcher, Remote Sensing Laboratory, Radio Propagation Research Center, Radio Research Institute Ph.D. (Engineering)

Biography

1993: Born in Niigata Prefecture.
2016: Graduated from Niigata University with a BS in engineering.
2019: Joined NICT while pursuing a Ph.D. at Niigata University's Graduate School of Science and Technology.
2021: Earned a Ph.D. in engineering from Niigata University's Graduate School of Science and Technology.

Awards, etc.

Won the Best Paper Award for FY2018/2019 from the Technical Committee on Antennas and Propagation, the Institute of Electronics, Information and Communication Engineers and the 2020 Student Award from the IEEE Antennas and Propagation Society's Japan Chapter

Q&As

Q When did you want to be a Researcher?

I recently ran into an elementary school classmate who told me that I had said as a child that I wanted to become a research scientist. I didn't believe him, but when I looked up my elementary school graduation essay, I found that I had actually said this in my own words. I made my dreams come true without even knowing it!

Q What is the biggest failure in you life so sar?

A This may not be my biggest mistake ever, but when I was in my doctoral program, I was receiving a loan-based scholarship. Because I failed to submit a waiver request, I'm still paying it back.

Q What are you interested in other than research?

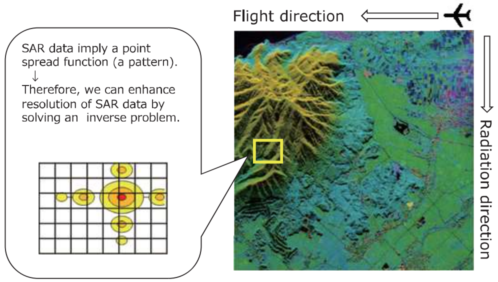
A Making coffee is a pastime of mine. I used an electric coffee grinder for a long time, but I recently switched to a manual grinder. I find that grinding coffee beans clears my mind.

Geographical survey products, including maps, are commonly used in daily life. While small-scale surveys can be achieved manually by geographic surveyors, global-scale surveys require the use of remote sensing technologies.

Radar—a remote sensing technology—is able to determine the distance of objects by transmitting radio waves, receiving their reflections and measuring the time elapsed between transmission and reception. In essence, a radar device produces an echo effect using radio waves. Through combined use of airborne SAR and sophisticated signal processing, two-dimensional images of land surfaces can be generated. Remote sensing from aircraft flying at high altitudes allows large areas to be surveyed quickly. NICT has been developing airborne SARs and making land surface observations using them since the 2000s.

I have been developing signal processing techniques to extract information from data collected by airborne SARs. My current main research focus is to develop signal processing techniques capable of enhancing the resolution of SAR images. The higher the SAR resolution (i.e., the smaller the area the SAR can resolve), the more detailed the land surface images the SAR can capture. However, SAR resolution is difficult to enhance due to certain limitations, including the radar frequency band. I have developed a signal processing technique to enhance the resolution of SAR images by removing the blurring caused by the point spread function of the SAR imaging system. This technique more than doubles SAR image resolution. This was achieved using a virtual frequency bandwidth two to three times wider than the actual radar frequency bandwidth SAR uses to collect data.

In future research, I will conduct in-depth testing to verify the performance of this technique. I will also further improve the technique with the aim of achieving its practical use.



The resolution of an SAR image (left) is determined by the pixel size of the imaging sensor and a consistent blur pattern created by the point spread function of the SAR imaging system. This blurring can be corrected by inversely solving the point spread function, thereby enhancing SAR resolution virtually.